Dark sector studies at Belle II

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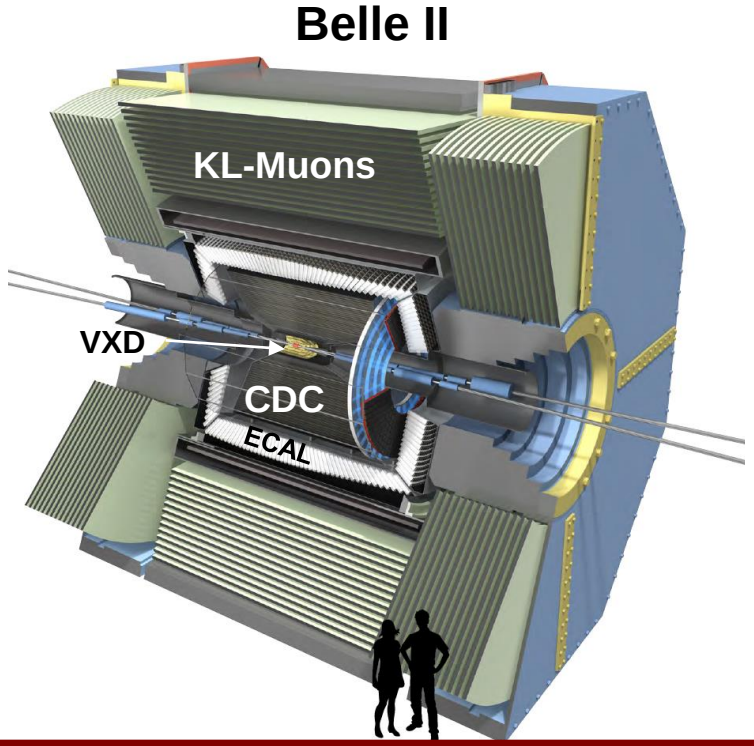
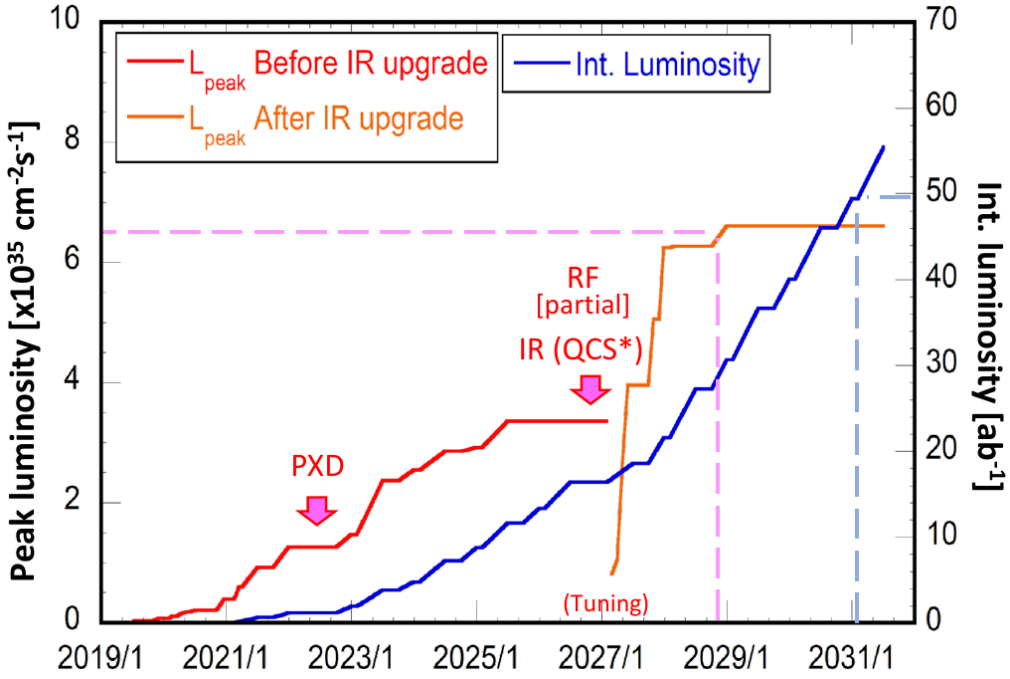
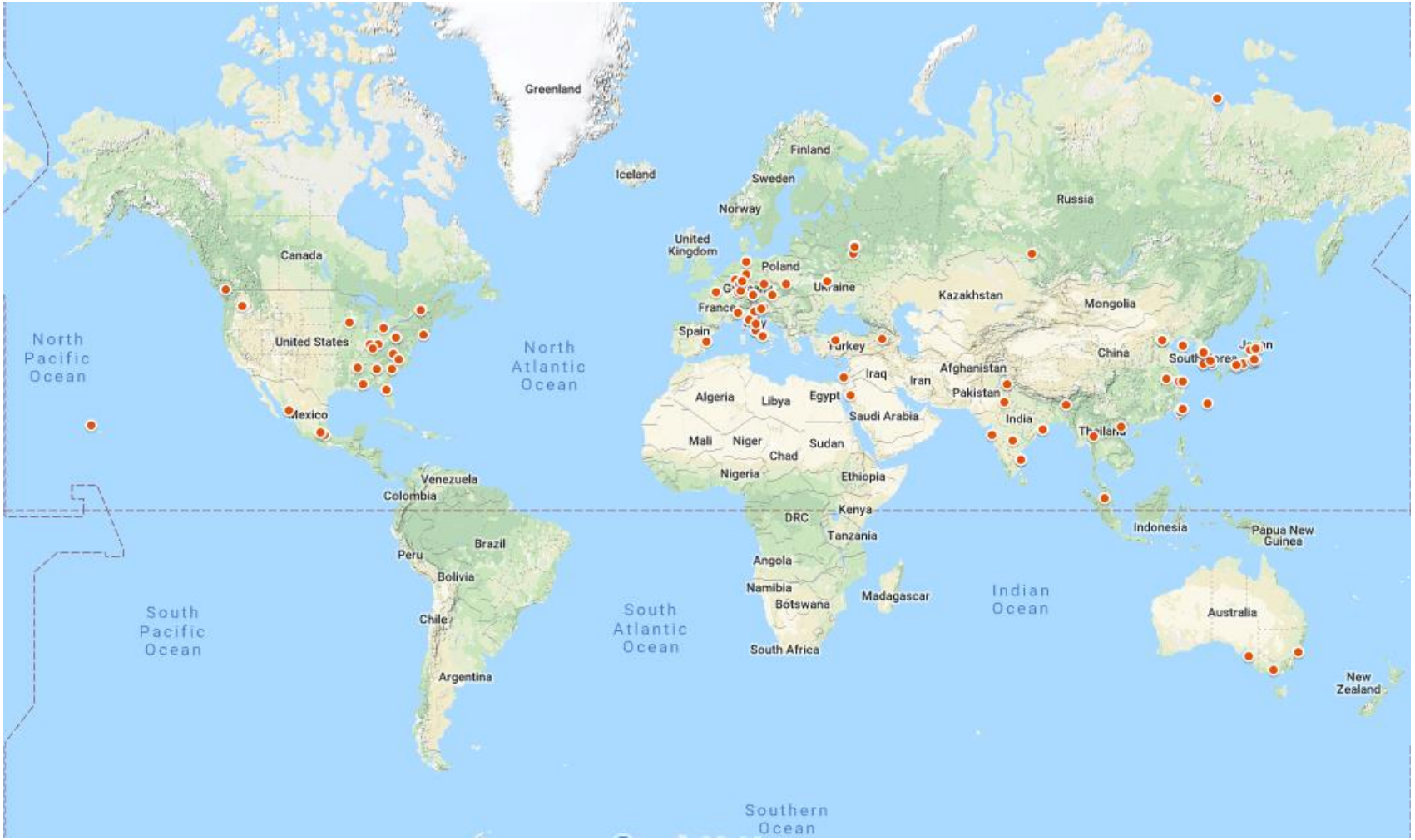
- The clean environment of low-energy e+e- colliders such as Belle II combined with a high-efficiency trigger for low-multiplicity events and an expected dataset around 50 ab^{-1} allows sensitive searches for an MeV/GeV scale dark sector.
- The Belle II detector is a near-4π detector with excellent charged particle vertexing, tracking and identification; EM calorimeter; and a dedicated KL-muon subsystem. SuperKEKB is on track to deliver 50 ab^{-1} over the next 10 years. Belle II has currently recorded 74 fb-1 at or slightly below the Y(4S).





International Belle II collaboration

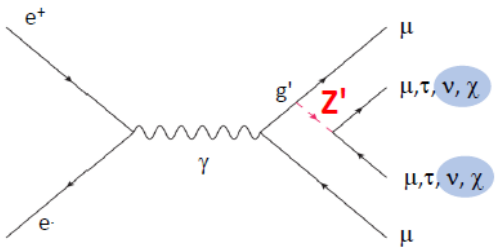
- The Belle II collaboration currently has ~1000 researchers from 26 countries.
- Youth and potential: There are ~330 graduate students in the collaboration.

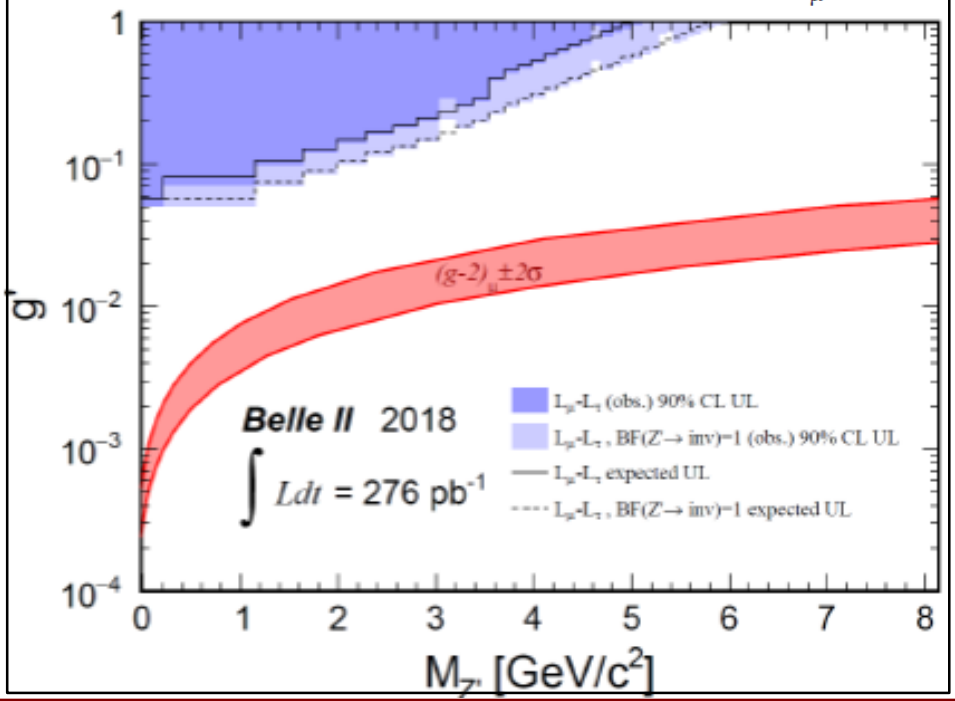


Brookhaven National Laboratory (BNL)
Carnegie Mellon University
Duke University
Iowa State University
Indiana University
Kennesaw State University
Luther College
Pacific Northwest National Laboratory (PNNL)
University of Cincinnati
University of Florida
University of Hawai'i
University of Louisville
University of Mississippi
University of Pittsburgh
University of South Alabama
University of South Carolina
Virginia Tech
Wayne State University

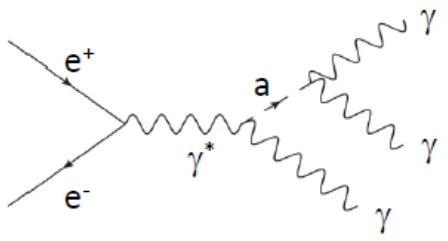
- Belle II's initial dark sector analyses were published/submitted this year:
  - Z' → invisible (PRL 124, 141801 [2020]), 76 pb^{-1} 2018 data
  - ALP → γγ (arXiv:2007.13071, to appear in PRL), 445 pb^{-1} 2018 data

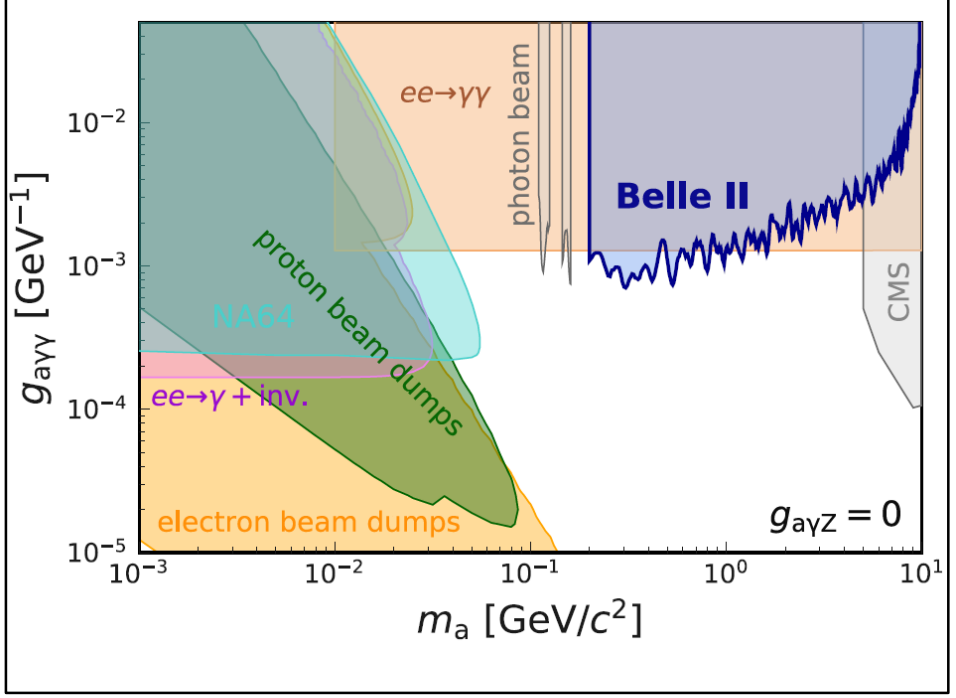
Z' → invisible





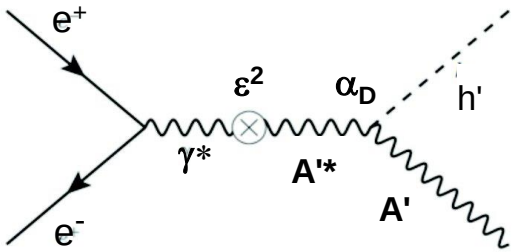
ALP → γγ

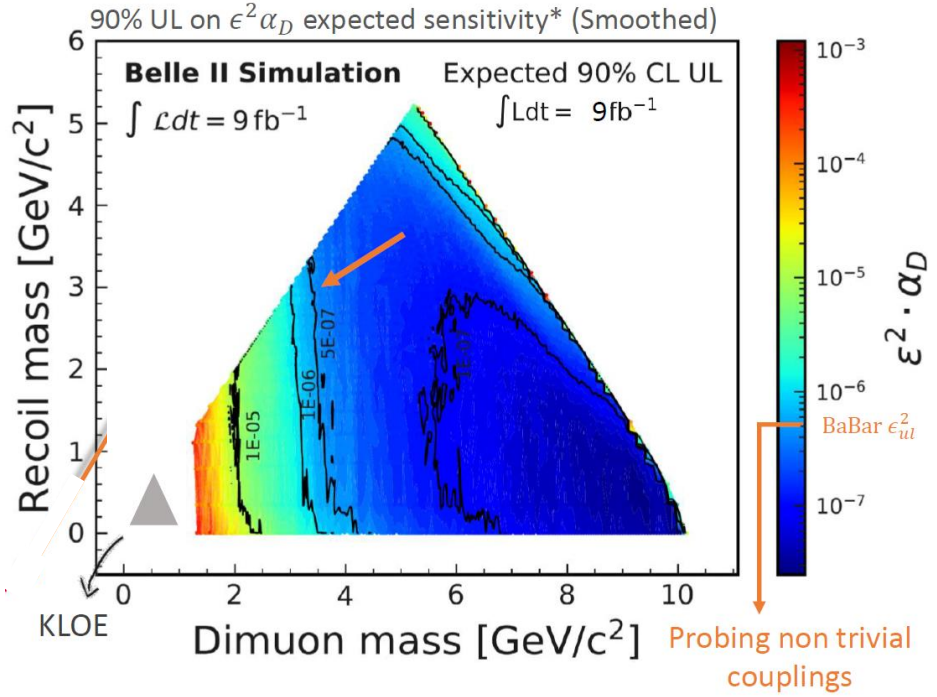




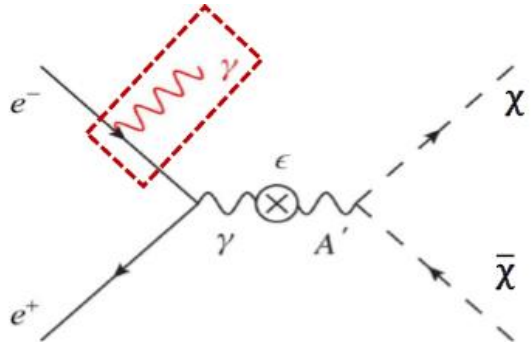
The next Belle II dark sector analyses expected are:

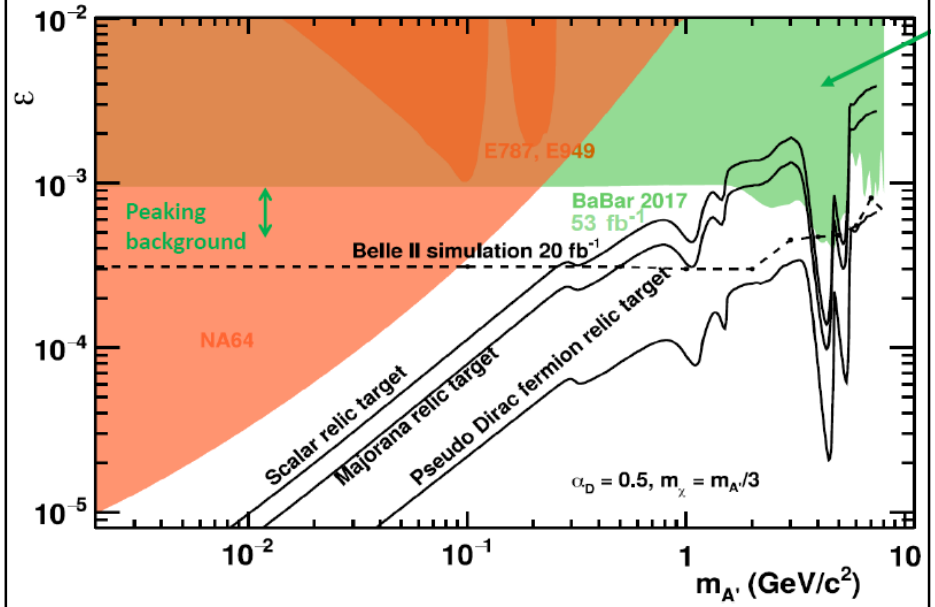
⇨ **Dark Higgstrahlung: A'h'** (μμ+missing) (first half 2021)





⇨ **Invisible Dark Photon (~ end 2021)**





Prospective Belle II Dark Sector Studies, White Paper(s)

- Belle II has a broad program of active and prospective dark sector searches which will be ripe for publication at various luminosity milestones:
  - Z', dark photons, dark scalars, vector mediators, light Higgs, LLPs/invisible decays (see earlier talk re Gazelle), iDM, ALPs, monopoles, sterile neutrinos in tau decays, ...

- Many of these topics are or will likely be advanced enough over the next several months to be substantively discussed in a Belle II dark sector Snowmass white paper(s).

- Prospective ideas and/or new areas for analyses will as well likely be identified and we welcome new contributions from both the theory and experimental communities that may help expand the scope and reach of Belle II in the dark sector.

Comments on the Snowmass Process

**** What would you like to come out of the Snowmass process?***

- ⇨ Dark sector physics searches are broadly spread across accelerator- and non-accelerator-based experiments using a wide variety of detector technologies and experimental methodologies. By bringing together the various communities of researchers as well as theorists, the Snowmass process will be invaluable in identifying possible synergies and redundancies across the experimental landscape, as well as highlighting cross-cutting issues that can help guide e.g. the theory community in optimally supporting experimentalists on current experiments and additionally suggesting possibly fruitful new avenues to explore.
- ⇨ For large experiments such as Belle II, the highly stratified organization by specific physics topics of the Snowmass process presents both an opportunity to showcase the totality of its very broad physics program, but it also presents the daunting challenge of bringing together all of the disparate threads to convincingly demonstrate that the "whole is greater than the sum of the parts."